CLAIMS

1. An implicit function rendering method of a nonmanifold, characterized in that an implicit function field of a nonmanifold is held in a form of volume data; a value of an implicit function at a point between lattice points is decided by interpolation; and if a difference in code distances between two adjacent voxels to be interpolated is larger than a fixed width, no surface is formed between the voxels.

2. The implicit function rendering method according to claim 1, wherein only when the following relations are all satisfied,

$u \in (-\infty), t)$ ... (2)

$v \in [t, \infty)$ ... (3)

$0 < ((-u)-t)+(v-t) < \alpha w$ ... (4)

but $\alpha (\geq 1)$,

wherein w is a space between two optional sample points; and u and v ($u \leq v$) are values, respectively, there is a surface between these two points.

3. The implicit function rendering method according to claim 2, wherein a surface position q ($\in [0, 1]$) is normalized so that a value can be on a lattice point of u when q=0 and can be on a lattice point of v when q=1; and the position q where there is a surface is obtained by the

following equation:

$$q=(t-u)/(v-u) \quad \ldots \quad (5)$$

4. An implicit function rendering method of a nonmanifold, characterized in that an entered curved surface is broken down into curved surface patches which enable determination of a front and a back; numbers are given to the front and the back, respectively, to be distinguished from each other; and a space is classified into a plurality of regions by using the number of a surface of a nearest point.

5. The implicit function rendering method according to claim 4, characterized in that:

(1) an input nonmanifold curved surface is divided along a branch line, broken down into curved surface patches having no branches;

(2) numbers i are allocated to the patches in an obtained order, a frond and a back of each patch are distinguished from each other, a number i^+ is given to the front, and a number i^- is given to the back;

(3) a space is sampled by a lattice point p, Euclid distance $d_E(p)$ to the curved surface and number i(p) of a surface of a nearest point are allocated to the lattice point;

(4) for each lattice point p, $i(p_n)$ is investigated at six adjacent points p_n, and groups of $(i(p), i(p_n))$ where $i(p)\neq i(pn)$ are enumerated;

(5) a group of new numbers are substituted for the group of

numbers prepared above, but if the numbers which are first i^+ and i^- become the same numbers as a result of the substitution, no substitution is carried out for a combination thereof, whereby numbers are arrayed in order from 0 at the end; and

(6) in accordance with a substitution table, a region number $i(p)$ is rewritten at each lattice point p, and an implicit function volume of a real value is constituted of the obtained volume region number $i(p)$ and the Euclid distance $d_E(p)$ to the surface at each voxel.

6. The implicit function rendering method according to claim 4, characterized in that:

a distance d^i_s included in a distance i is as follows:

$$d^i_s \in [D_s i,\ D_s(i+1))\ \ldots\ (6)$$

wherein D_s is a width of each divided region of a real valued space representing a distance; and

in a position p of each voxel, a region distance $f_s(p)$ is calculated from $d_E(p)$ and $i(p)$ by the following equation:

$$f_s(p)=\min(d_E,\ 2^B-\varepsilon)+2^B i(p)\ \ldots\ (7),$$

$\varepsilon(>0)$ is set to a minute positive real number to round down $d_E(p)$ so that fs(p) can be included in a half-open section of (6).

7. The implicit function rendering method according to claim 4, characterized in that:

only when the followings are all satisfied,

$u \in (2^B i,\ 2^B(i+1)$ ... (8)

$v \in [2^B j,\ 2^B(j+1))$ ... (9)

$0<(u-2^B i)+(v-2^B j)<\alpha w$ ... (10)

but i, j ($0 \le i \le j \le n-1$), $\alpha(\ge 1)$,

wherein w is a space between two optional sample points; and u and v ($u \le v$) are values, respectively, there is a surface between these two points.

8. The implicit function rendering method according to claim 4, characterized in that:

a surface position q ($\in [0,\ 1]$) is normalized so that a value can be on a lattice point of u when q=0 and can be on a lattice point of v when q=1; and the position q where there is a surface is obtained by the following equation:

$q=(u-2^B i)/((u-2^B i)+(v-2^B j)$ ... (11)

9. A direct drawing method of an implicit function curved surface, characterized in that a texture T_{front} representing a volume value of a slice front side and a texture T_{back} representing a volume value of a slide backside are used to interpolate and display a volume value of a region surrounded with the slice front side and the slice backside.

10. The direct drawing method of the implicit function curved surface according to claim 9, characterized

in that:

intersection points between a visual line and the slice front side and the slice backside are calculated; and from a textural value t_{front} of the slice front side and a textual value t_{back} of the slice backside, an influence of a volume located on the visual line between the slices on a color and a degree of transparency observed in this position is calculated to be displayed on a polygon.

11. The direct drawing method of the implicit function curved surface according to claim 9 or 10, characterized in that:

a process of calculating an observed color and an observed degree of transparency from the group of the textural value t_{front} and the textural value t_{back} is carried out beforehand; and a result thereof is saved as a two-dimensional texture in a graphics card on a simplified chart to be referred to by using a texture combining function during drawing.

12. The direct drawing method of the implicit function curved surface according to claim 9 or 10, characterized in that:

an implicit function curved surface represented by a region distance field volume is converted into such a form as to be used as a 3D texture; and with respect to a group of optional region distances constituted of the textural values

t_{front}, t_{back}, a process of calculating a color and a degree of transparency observed therebetween is carried out beforehand to prepare a simplified chart, whereby a drawing color is decided.

13. A computer program, characterized by causing a computer to execute the method of claims 1 to 3.